NON-PROVISIONAL PATENT APPLICATION

FOR

UNITED STATES LETTERS PATENT

OF

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FOR

IMPROVED DENTURE AND PROCESS FOR MANUFACTURING ARTIFICIAL TEETH FOR DENTURES

Docket No.: 01-7571-04
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REFERENCE TO RELATED APPLICATION

This Non-Provisional Patent Application claims benefit of U.S. Provisional Patent Application Serial No. 60/445,576 filed 02/06/03, and hereby claims the benefit of the embodiments therein and of the filing date thereof.

BACKGROUND OF THE INVENTION

This invention relates to the manufacture of artificial teeth for installation in metal or plastic base installed in the wearer's mouth. The teeth and the base constitute a denture which may include any number of teeth up to and including the entire upper or lower dentures or plates.

Currently, such artificial teeth are usually formed of one of two materials. Either they are of porcelain, which has been recognized as being too hard, or they are of a plastic material, which is too soft. Porcelain teeth are typically formed of molded porcelain. Since porcelain is quite brittle, in addition to being very hard, porcelain teeth are subject to mechanical failure from cracks. The other principal disadvantage of porcelain teeth is that, because of their hardness, they tend to wear or damage opposing natural dentition.

Plastic teeth have been more popular than porcelain because of the above disadvantages. But since they are softer, they tend to wear away rapidly. As they become worn, they no longer exert the normal force on the opposing natural dentition, permitting the natural teeth to move, and throwing off the patient's bite and function.

Many efforts have been made to produce plastic materials which are harder and less susceptible to wear but none are comparable to natural dentition.

In recognition of the above problems, many workers have sought to employ various polyceramic mixtures and similar materials in an effort to provide a suitable denture material, which has hardness closer to natural dentition.

Patents describing composition intended for use in dental applications include:

U.S. Patent 3,975,203 to Dietz

U.S. Patent 4,131,597 to Bluethgen

U.S. Patent 5,346,397 to Braiman

U.S. Patent 5,447,967 to Tyszblat

U.S. Patent 5,621,035 to Lyles

The above listed patents are merely exemplary of the many patents issued in this field.

SUMMARY OF THE INVENTION

Applicant has provided a method of making artificial teeth which are harder than plastic but not as hard as porcelain. Materials have become available described as polycarbonate dimethacrylate and marketed by Pentron Laboratories Technologies and sold under the names of Sculpture® and Sculpture® Plus which are designed to create metal-free, restorative dental composites.

It occurred to applicant that the Sculpture® material, which is useful for restorative dental composites, might also be used to produce entire new artificial teeth. Using the Sculpture® Plus material applicant made excellent artificial teeth by the following:

1) using as a mold an existing tooth or a molded plastic tooth, a mold form of impression material is produced;

2) a thin layer (1 mm) of Sculpture® Plus incisal material is placed in the bottom of the mold form;

3) this layer is cured by exposure first for five minutes to a vacuum in a nitrogen atmosphere and then for three more minutes to a curing lamp in a vacuum, also in a nitrogen atmosphere;

4) subsequent layers (approximately 2 mm) are built up in the mold form, exposed to the same curing process as above, until the mold form is full coloring each layer as desired;

5) removing the tooth from the mold form and subjecting the tooth to the same curing process as above;

6) inspecting the tooth for voids and filling any voids with incisal material and smooth or buff;

7) create retention holes in the bottom of the tooth;

8) lightly blast the tooth with white aluminum oxide and rinse or steam clean;

9) glaze, if desired, and cure the tooth in nitrogen atmosphere for nine minutes; and

10) cure the tooth in a heat-curing oven for approximately twenty minutes.

BRIEF DESCRIPTION OF THE DRAWINGS

This invention may be more clearly understood with the following detailed description and by reference to the drawings in which:

Fig. 1 is an enlarged perspective view of an original denture tooth or newly fabricated plastic tooth with a handle attached;

Fig. 2 is a perspective view of a tray for holding molds for teeth;

Fig. 3 is a sectional view of a mold after the original tooth has been removed;

Fig. 4 is a sectional view of the mold of Fig. 3 as incisal material is added;

Fig. 5 is a sectional view of the mold of Fig. 4 after additional layers of incisal material have been added;

Fig. 6 is a side elevational view of a tooth after being removed from the mold and ready for inspection;

Fig. 7 is a side elevational view showing a posterior tooth following the curing step with a transverse retention hole created across the bottom base;

Fig. 8 is a side elevational view of a posterior tooth, partly in section, with the base undercut to provide a retention cavity;

Fig. 9 is a side elevational view of an anterior tooth with its base undercut;

Fig. 10 is a perspective drawing of a tooth supported by tweezers in the hand of an individual;

Fig. 11 is a flow diagram showing the steps of manufacturing a tooth according to the invention; and

Fig. 11A is a flow diagram indicating a modification of the steps of Fig. 11.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A survey of the materials available for forming teeth for dentures disclosed that most had significant disadvantages. A proprietary material of Pentron Laboratories Technologies, 53 North Plains Industrial Road, Wallingford, CT 06492, sold under the name "Sculpture®", was found to be the most satisfactory in that it is stain resistant, somewhat shock absorbing, and has wear characteristics similar to natural teeth. In working with this and other materials, the applicant developed artificial teeth and a process for making such teeth, which resulted in a greatly improved product, compared with those presently in use.

More recently, Pentron Laboratories Technologies has developed an improved dental composite now identified as Sculpture® Plus, which is believed to provide superior chip, stain and wear resistance. The use of this material results in a modification of the process described below. These modifications will be discussed in comparison with the process using the composition described as Sculpture®. Both materials use an indirect composite such as a polycarbonate dimethacrylate stated to be a proprietary material of Pentron Laboratories.

When a new denture is to be provided for a patient, the dentist designs the denture for the patient, choosing the shape and color of the denture teeth to be made. This specification is supplied to a dental laboratory that proceeds to manufacture the teeth according to the dentist's design. The process of creating new artificial teeth is essentially the same irrespective of which, or how many, teeth are to be made. Teeth from an existing denture can be used effectively as a die to form molds for the new

teeth or, if such teeth are broken, excessively worn, or unavailable, new plastic teeth suitable as a die can be made by an existing well known process. Where possible or available, stone molds of the patient's original teeth can be used. This would make it possible to duplicate the shape of the patient's natural teeth.

Initially, such an old denture tooth or plastic tooth used as a die has fastened to its bottom side a plastic stem or small handle by means of a suitable adhesive such as Zapit® from Dental Ventures of America (1-800-228-6696). This is shown in Fig. 1 wherein tooth **10** has affixed to itself a plastic handle **12** by means of a suitable adhesive **14**. Zapit® has been found satisfactory since it sets up quickly and breaks off cleanly.

It has been found useful to create a multi-position mold form by cutting an ice cube tray in half horizontally to create a series of small mold forms of essentially identical depth. Other ways to create mold forms could be used. The mold, which may be formed in the aforementioned cut down ice cube tray **16** or other mold form is then formed by squeezing into one of its divisions **18** enough impression material, such as "Panasil Contact Plus™" to fill the division to the desired depth. See Fig. 2.

Next, a small amount of the impression material is applied with a finger to the surface of the form tooth. Holding the plastic handle, the form tooth is then pushed into the impression material up to the base, leaving the bottom and the adhesive area exposed. It has been found that the small finger applied layer of impression material tends to prevent bubbles from occurring in the molds. The die or form tooth is left in the mold for at least ten minutes and then removed. The mold or set impression **18** is then removed from the tray **16**.

Fig. 3 is a sectional view of the set impression after removal of the tooth from the mold **18** leaving an impression **19**. The above process is repeated for each tooth required for the desired denture. The mold **18** is for a specific tooth only and is numbered and labeled for identification.

Fig. 4 is a side elevational view, partly in section, showing the mold **18** with a small amount of the clear incisal **20** (indirect composite material) placed in impression **19**, such as the Sculpture® or Sculpture® Plus material referred to above, which is smashed or forced in and adapted in small amounts to the contour of the mold **18** by means of a small instrument which serves as a pestle, while the mold serves as a mortar to conform the clear incisal to the impression **19**. This layer of sculpture material is then cured for ten seconds under a curing light. Other layers **22** of clear incisal sculpture material (about 1 mm at a time) are added until the mold is filled and each layer is cured for ten seconds under a curing light. See Fig. 5. Color material is added as required for each increment. Normally, darker color is added for about the lower one-half of the height of the tooth and lighter color for the upper one half to match the pattern of natural teeth. A very small amount of thinning liquid, such as Sculpture® Plus Thinning Liquid, may be used to prevent the incisal material from sticking to the instrument used for adaptation. After the incisal color is in the mold (with the body and sides 1/3 of the way down and tapped very thin), body color is added and cured in the mold until the mold is full.

The tooth is then carefully removed from its mold **18** while under light cure and placed in a separate light curing oven for nine minutes. Following this curing step, the tooth is allowed to cool and inspected for any voids or other imperfections, and any

such voids that are found are filled. The tooth is then lightly smoothed with a white rubber wheel.

When Sculpture® Plus material is used, it has been found useful to subject an initial 1 mm layer to a five minute vacuum cycle (approximately 29 in. Hg) in a nitrogen (oxygen-free) atmosphere followed by a three minute vacuum (approximately 29 in. Hg) segment with exposure to curing light. Subsequent layers may be approximately 2 mm or somewhat thicker until the mold is filled. All the foregoing described steps are preferably performed in a Sculpture® curing light which is a proprietary product of Pentron Laboratories Technologies and which automatically provides the described vacuum, light (and heat) curing cycles in a nitrogen atmosphere.

The vacuum applied in a nitrogen atmosphere during both the initial stage and the light-cure stage (which includes significant heat from the lamps) provides enhanced bonding between layers and removes flaws or voids.

In a final cure cycle, after the tooth is removed from the mold, the above process is followed with the cure chamber purged of oxygen using nitrogen. This produces a hard outer surface receptive to polishing.

Fig. 6 is a side elevational view of a tooth **24** following filling any voids and buffing with the rubber wheel and ready for inspection.

A further step is to create one of more retention holes in the bottom of the tooth, undercutting them as shown in Figs. 7, 8, 9, or 10. This process has been named "MECHANICAL ORB RETENTION (M.O.R.)".

Fig. 7 is a side elevational view of a posterior tooth following inspection and with a retention hole created on its base. The holes are on the proximal sides of the base to

create a tunnel effect. A half round #1 or #2 round burr may be used on the sides.

Fig. 8 shows a tooth similar to that of Fig. 7 but is partly in section showing an undercut retention hole.

Fig. 9 is a side elevational view of an anterior tooth made according to the above-described process and having a retention hole on the bottom base shown in dashed outline. The anterior teeth do not have the holes in the sides, but the bottom retention hole includes an internal undercut. These internal holes should not be visible from the front of the tooth when held up to light because the pink acrylic substrate may show when the denture is completed.

Next, the tooth is lightly sand blasted with an abrasive such as white **50** micron aluminum oxide followed with a thorough rinse in distilled water in an ultrasonic cleaner for about two minutes or steam cleaned. The tooth is then dried. After the cleaning step, the tooth is stained, if needed or desired, and a small amount of glaze, such as Sculpture® Plus LD Glaze, is applied with a brush or hand polish with Sculpture® Glo.

Following the application of the glaze material, the tooth is held by a suitable holder such as tweezers in the retention hole, as shown in Fig. 10, and is seated on a glazing dome (which may be the Sculpture® curing light described above), base side down. Nitrogen gas is introduced into the dome and the tooth and dome are exposed to a light curing oven under vacuum for another nine minutes, following which they are exposed to a heat-curing oven for twenty minutes. The teeth are then removed from the curing oven and allowed to cool.

The tooth is now inspected and if at all tacky, buffed lightly with a chamois wheel.

The tooth is then completed and is ready to be installed in a substrate, which will

vary depending upon the location, number of teeth, etc. These factors also influence whether the substrate is partly of metal. In any event, the tooth will normally be molded into a substrate consisting of pink acrylic, which flows into the retention hole or holes formed as described, holding the tooth or teeth very securely.

Fig. 11 is a flow diagram showing in detail the process described above using Sculpture® incisal material.

Fig. 11A is a flow diagram showing a modification of the process of Fig. 11 when using Sculpture® Plus incisal material.

The above-described embodiments of the present invention are merely descriptive of its principles and are not to be considered limiting. The scope of the present invention instead shall be determined from the scope of the following claims including their equivalents.